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AN ADDITION TO OPTIMIZATION OF PARAMETERS IN Ti-ALLOYS

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ABSTRACT
Due to its characteristics, titanium is a material that engineers increasingly use and many call it a material of the future. Fields of application are not closely confined to air and missile industry, but have spread to almost all spheres of human creation. The limiting factor is still the price of titanium. Previous workability studies of Ti-alloys grinding finish do not provide sufficient answers in which area (which parameters) processing should be done. Although, essentially, the process of grinding, can be reduced to the classical process, it still contains many undetermined factors, so that the empirical and theoretical data of different authors differ greatly.
Keywords: Ti-alloys, machining, grinding

1. INTRODUCTION
According to demands of modern production and a techno-economic analysis of treatment operations, treatment process project should include a defining of optimal parameters in order to reduce both the costs and production time.
The parameters need to provide a predifined quality nad process cost-effectiveness. The starting point are technological and technical demands whenever treatment parameters are determined in regards to rigidity and efficiency of installed power of the treatment system.
Many significant parameters influence roughness of the treated surface (Fg. 1). By managing those parameters, it is possible to get necessary values of roughness (R_a, R_z, R_{max}). The real resting surface depends on roughness and treatment procedure so for the asperity height of 2,5÷8 μm (grinding) the contact surface is 10%; for the height of 0,8÷2,5 μm the resting surface is 40%, whereas for fine treatment (fine grinding) the resting surface is up to 90%.
The paper provides comparative values of roughness of a Č.1530 i TA6V sandwich construction.

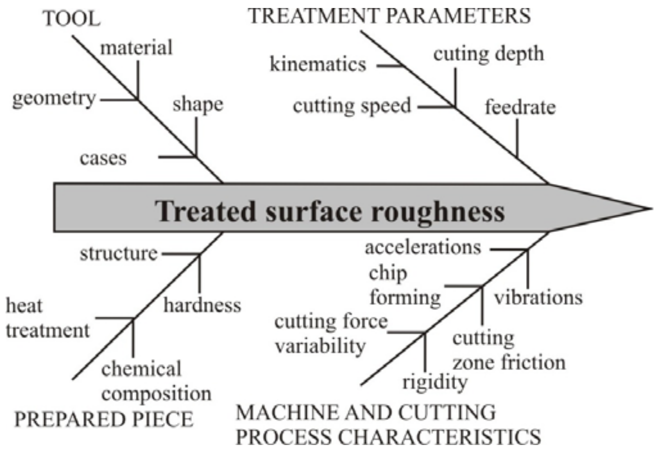

Figure 1. Influence parameters to the roughness of the treated surface

2. EXPERIMENT CONDITIONS OF DETERMINING OF TREATED SURFACE QUALITY OF A Č.1531-TA6V SANDWICH CONSTRUCTION

2.1. MATERIAL

The tube material (sandwich construction) is commercial steel, made by hot rolling. The material is then thermally treated by means of normalizing and annealing, and the other material is an alloy.

Table 1. Mechanical characteristics and chemical composition of the tube material

<table>
<tr><td rowspan="6">Č.1331 BAS
Cg 32 DIN
1.0612 WNr</td><td colspan="7">Mechanical characteristics</td></tr>
<tr><td>Ultimate strength N/mm^2</td><td>Stretch limit N/mm^2</td><td>Hardness HB</td><td colspan="2">Ductility A_5 %</td><td colspan="2">Contraction %</td></tr>
<tr><td>650</td><td>420</td><td>179</td><td colspan="2">24,2</td><td colspan="2">48,2</td></tr>
<tr><td colspan="7">Chemical composition %</td></tr>
<tr><td>C</td><td>Si</td><td>Mn</td><td>P</td><td>S</td><td>Ni</td><td>Mo</td></tr>
<tr><td>0,467</td><td>0,309</td><td>0,657</td><td>0,0141</td><td>0,0211</td><td>0,0339</td><td>0,0087</td></tr>
<tr><td rowspan="6">Titanium alloy
T-A6V</td><td colspan="7">Mechanical characteristics</td></tr>
<tr><td colspan="2">Ultimate strength N/mm^2</td><td colspan="2">Stretch limit N/mm^2</td><td colspan="2">Hardness HB</td><td>Ductility A_5 %</td></tr>
<tr><td colspan="2">400-900</td><td colspan="2">500-600</td><td colspan="2">200-220</td><td>20-25</td></tr>
<tr><td colspan="7">Chemical composition %</td></tr>
<tr><td>Al</td><td>V</td><td>Fe</td><td>C</td><td>N_2</td><td>O_2</td><td>Ti</td></tr>
<tr><td>6,87</td><td>4</td><td>0,13</td><td>0,08</td><td>0,07</td><td>0,02</td><td>Other</td></tr>
</table>

2.2. Tube Shape

Sl.2. Tube shape

2.3. Tool - Whetstone

We used a whetstone labeled 2B 46 J 6V, manufacturer "SWATY", Tovarna umjetnih brusov, ISO 525. Whetstone dimensions ϕ250x35x26.

2.4. Measuring Spot

Surface roughness measuring device – profilmeter. In order to acquire data on the quality of the treated surface, we used a Surface roughness measuring device (R_a, R_z, R_{max}) manufacturer Mitutoyo, labeled SJ-201P, of the referential length of 2,5 mm.

3. EXPERIMENT RESULTS

Table 2. The result of measuring of the quality of sandwich construction treated surface

								Č.1530			*TA6V*		
	Table feedrate *s* [*mm/o*]	Cutting depth *t* [μm]	Table speed *v* [*m/min*]	X_0	X_1	X_2	X_3	R_a [μm]	R_a Computer	ln R_a	R_a [μm]	R_a Computer	ln R_a
13	4	0,015	10	1	1	1	1	0,65	**1,1623**	-0,43	1,37	**1,427769**	0,31
10	1	0,015	10	1	-1	1	1	1,30	**1,2200**	0,26	1,90	**1,954877**	0,64
6	4	0,005	10	1	1	-1	1	0,78	**0,6583**	-0,25	0,75	**1,00165**	-0,29
15	1	0,005	10	1	-1	-1	1	0,62	**0,6910**	-0,48	1,57	**1,371442**	0,45
4	4	0,015	2	1	1	1	-1	1,40	**1,0169**	0,34	1,90	**1,846008**	0,64
1	1	0,015	2	1	-1	1	-1	0,95	**1,0673**	-0,05	2,30	**2,527522**	0,83
2	4	0,005	2	1	1	-1	-1	0,40	**0,5760**	-0,92	1,40	**1,295065**	0,34
5	2	0,008	4,47	1	0	0	0	1,00	**0,8382**	0,00	1,80	**1,666714**	0,59
3	1	0,005	2	1	-1	-1	-1	0,45	**0,6045**	-0,80	1,40	**1,773181**	0,34
8	2	0,008	4,47	1	0	0	0	1,10	**0,8382**	0,10	1,60	**1,666714**	0,47
12	2	0,008	4,47	1	0	0	0	1,00	**0,8382**	0,00	1,90	**1,666714**	0,64
14	2	0,008	4,47	1	0	0	0	1,10	**0,8382**	0,10	1,80	**1,666714**	0,59

The results gained from the Table 2. give us:

$$R_a = \frac{8{,}85 \cdot t^{0{,}51743} \cdot v^{0{,}08306}}{s^{0{,}0349}} [\mu m] \qquad Č.1530$$

$$R_a = \frac{10{,}95 \cdot t^{0{,}32265}}{s^{0{,}2267} \cdot v^{0{,}1596}} [\mu m] \qquad TA6V$$

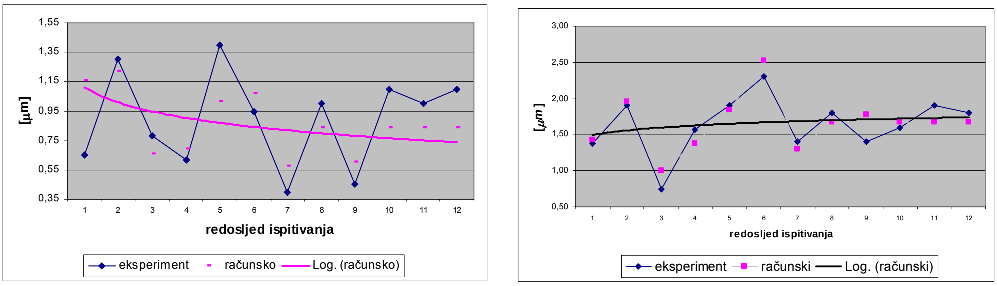

Figure 3. An overview of computer-generated and experimental results of roughness R_a - Č.1530 and R_a - TA6V

4. CONCLUSION

Based on the technological knowledge and conducted experiments of sandwich construction titanium alloy TA6V and Č.1530 grinding, we can conclude that:

- Input parameters optimization (cutting speed, feedrate and cutting depth) on the basis of set treatment limitations (machine and tool characteristics and accuracy of the treated surface), and with the goal of achieving one or more functions of the goal, such as minimization of unit treatment costs and/or minimization of unit treatment time, as well as an application of material workability criteria, have, from cost efficiency point of view, have the largest practical value and meaning in the production environment.
- It is noticeable that tools with recommended workability characteristics have a significantly lower consistency that in case of grinding conventional materials.
- Of all cutting parameters for all cases of testing, feedrate has the biggest influence, whereas, on the contrary, speed has very little influence on the resistance and roughness parameter R_a
- While analyzing parameters R_a it is noticeable that the roughness of the treated surface is mostly formed under the influence of geometrical influences related to the tools and feedrate, while the influence of elastic-plastic deformities is minimal.

5. REFERENCES

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